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Determination of Arsenic and Chromium Oxidation States in Contaminated Soils

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Introduction: The goal of this research was to determine the chemical speciation and mobility of heavy metals and metalloid contaminants in soils surrounding abandoned waste incinerators at outlying airfields associated with a US Marine Corps base. This information will be used to determine whether the contaminants can be safely managed in place (in-situ remediation), which is less costly than soil excavation and treatment.

Methods and Materials: Chromium and arsenic K-XANES analyses were performed on moist, whole soil samples to determine the oxidation states of these elements. The samples contained very low concentrations of these elements (8.7 to 15 mg As/kg and 3.6 to 14 mg Cr/kg). XANES data were collected in fluorescence mode using a multi-element detector.

Results: A comparison of As K-XANES spectra for soil samples with standards of As(III) and As(V) indicated that As(V) was dominant oxidation state in the soil samples (Figure 1). Arsenic(V) is considered to be the less mobile and less toxic form of As in soils. As previously found by other researchers studying Cr, we obtained a linear relationship between the proportion of Cr(VI) in mixed Cr(III)/Cr(VI)-oxide mineral standards and the area under the pre-edge peak for Cr(VI) at 5994 eV (data not shown). The absence of a pre-edge peak in soil samples (not shown) indicated that Cr(III) was dominant in these samples.

Conclusions: Soil samples from around incinerator sites contained predominantly As(V) and Cr(III), the less toxic and less mobile forms of these elements when in soils. The XANES results, along with results of laboratory mobility studies, indicated that metal contaminants at the incinerator sites could be managed in place.

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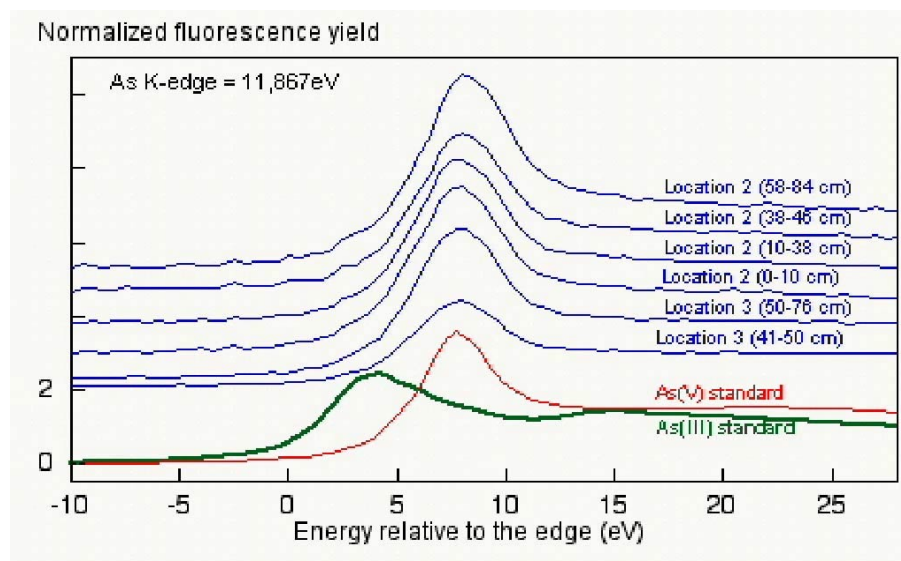


Fig. 1. Stacked arsenic K-XANES spectra for soil samples collected at various depths from sampling locations around the incinerator at MCALF-Bogue Site 27 indicated a dominance of As(V) in the soil.